axis 13 of the array stretched along the 480 mm length. Four dual polarized, crossed-dipole radiating elements were used. The first radiating element was placed 60 mm from the edge, the second element was placed 120 mm from the first element, the third 120 mm from the second element, and the fourth 120 mm from the third element. The elements were aligned along the vertical axis of the array having slant angles of +45 degrees and –45 degrees with respect to the vertical axis 13 of the array.

Two supports were situated 120 mm from the edges of the ground plane and perpendicular to the vertical axis of the array. The supports were 75 mm tall and had a thin, rectangular parasitic element placed on top. The parasitic element was 5 mm wide and 150 mm long. The parasitic elements were placed at the top of the support and extended along the full length of the support.

Referring now to FIGS. **5** and **6**, an array **210** of crossed, dual-dipole radiating elements **202**, **203**, and **204** are attached to a ground plane **201** to operate in the cellular band of frequencies of 820–960 MHz. As discussed above, the composition and dimensions of the ground plane **201** and the radiating elements **202, 203,** and **204** determine the radiation characteristics, beam width, and the impedance of the antennas.

The radiating elements **202**, **203**, and **204** transmit and receive electromagnetic signal transmissions and are comprised of pairs of dipoles, **211***a* and **211***b*, **212***a* and **212***b*, and **213***a* and **213***b*, respectively. The dipoles comprising the radiating elements **202**, **203**, and **204** are crossed and configured with 45 degree slant angles (with respect to the axis of the array **215**). That is, the axes of the dipoles are arranged such that they are parallel with the polarization sense required. As shown, the slant angles +α and –α are +45 degrees and –45 degrees, respectively. Although shown with slant angles of +45 degrees and –45 degrees, it will be understood by those skilled in the art that these angles can be varied to optimize the performance of the antenna. A front side wall **207** and rear side wall **208** contribute to the radiation characteristics of the antenna.

Each of the radiating elements **202, 203,** and **204** receive signals having polarizations of +45 degrees and –45 degrees. The received signals from parallel dipoles **211***a*, **212***a*, and **213***a*, or **211***b*, **212***b*, and **213***b*, are combined using a feed network for each polarization. The feed network is composed of coaxial, microstrip, stripline, or other types of transmission lines. A diversity receiver connected to the antenna then chooses the strongest amongst these two combined signals for further processing. Each of the elements **202, 203,** and **204** can also act as a transmitter provided that the transmitted signal is at a different frequency than the received signal.

A parasitic element **205** is supported and elevated by pairs of rod supports **206***a* and **206***b*. The parasitic element preferably acts as a de-coupling rod. The parasitic element is perpendicular to the vertical axis **215** of the array. The rod supports are constructed of a non-conducting material. Although one parasitic element is shown, it will be understood that the exact number of parasitic elements can be varied and depend upon the exact configuration and other required characteristics of the antenna.

Referring now to FIGS. **7** and **8**, an array **310** of crossed, dual-dipole radiating elements **302, 303,** and **304** are connected to a ground plane **301** to operate in the cellular band of frequencies of 820–960 MHz. As discussed above, the composition and dimensions of the ground plane **301** and radiating elements **302, 303,** and **304** determine the radiation characteristics, beam width, and the impedance of the antennas.

The radiating elements **302**, **303**, and **304** transmit and receive electromagnetic signal transmissions and are comprised of pairs of dipoles, **311***a* and **311***b*, **312***a* and **312***b*, and **313***a* and **313***b*, respectively. The dipoles comprising the radiating elements **302**, **303**, and **304** are crossed and configured with 45 degree slant angles (with respect to the axis of the array **315**). That is, the axes of the dipoles are arranged such that they are parallel with the polarization sense required. As shown, the slant angles +α and –α are +45 degrees and –45 degrees, respectively. Although shown with slant angles of +45 degrees and –45 degrees, it will be understood by those skilled in the art that these angles can be varied to optimize the performance of the antenna. A front side wall **307** and rear side wall **308** contribute to the radiation characteristics of the antenna.

Each of the radiating elements **302, 303,** and **304** receive signals having polarizations of +45 degrees and –45 degrees. The received signals from parallel dipoles **311***a*, **312***a*, and **313***a* or **311***b*, **312***b*, and **313***b*, are combined using a feed network for each polarization. The feed network is composed of coaxial, microstrip, stripline, or other type of transmission line. A diversity receiver connected to the antenna then chooses the strongest amongst these two combined signals for further processing. Each of the elements **302, 303,** and **304** can also act as a transmitter provided that the transmitted signal is at a different frequency than the received signal.

A first parasitic element **305***a* is supported and elevated by rod supports **306***a* and **306***b*. The parasitic element **305***a* is parallel to the vertical axis **315** of the array. Additionally, a second parasitic element **305***b* is supported and elevated by rod supports **306***c* and **306***d*. The parasitic element **305***b* is also parallel to the vertical axis **315** of the array and acts as a de-coupling rod. The rod supports are constructed of non-conducting material. Although two parasitic elements are illustrated in this embodiment, it will be understood that the number can be varied according to the exact configuration and operating characteristics of the array.

Thus, an antenna array is provided which is comprised of dual polarized radiating elements and produces two orthogonally polarized signals. Furthermore, the invention provides an antenna array where the antennas are comprised of crossed-dipole elements and which improves isolation between the electromagnetic fields of the crossed dipole elements. An antenna has also been provided which minimizes the number of antennas required in a wireless telecommunication system thereby providing an aesthetically pleasing structure that is of minimum size and scale.

While the present invention has been described with reference to one or more preferred embodiments, those skilled in the art will recognize that many changes may be made thereto without departing from the spirit and scope of the present invention which is set forth in the following claims.

We claim:

1. An antenna for simultaneously receiving separate electromagnetic signals comprising:

a ground plane with a length and having a vertical axis along said length;

a plurality of dipole radiating elements, said radiating elements comprised of first and second co-located, orthogonal dipoles, said dipoles aligned at first and second predetermined angles with respect to said vertical axis, said radiating elements and ground plane producing first electromagnetic fields in response to said electromagnetic signals;

a plurality of non-conductive supports, said supports connected to said ground plane and perpendicular to said vertical axis and placed between selected of said plurality of dipole radiating elements;

a plurality of independent metallic parasitic elements unconnected to said dipoles and placed in a selected of said plurality of supports, said first electromagnetic fields exciting currents in said metallic parasitic elements, said currents creating second electromagnetic fields, said second electromagnetic fields canceling with portions of said first electromagnetic fields.

2. The antenna of claim **1** whereby said first predetermined angle is substantially equal to +45 degrees with respect to said vertical axis and said second predetermined angle is substantially equal to −45 degrees with respect to said vertical axis.

3. The antenna of claim **1** wherein said parasitic elements are composed of aluminum.

4. The antenna of claim **1** wherein said support comprises an upper surface and said parasitic elements are positioned along said upper surface of said support.

5. The antenna of claim **1** wherein said plurality of supports is located midway between said radiating elements.

6. The antenna of claim **1** wherein said ground plane is composed of metal.

7. The antenna of claim **1** wherein said plurality of radiating elements includes exactly four radiating elements.

8. The antenna of claim **7** wherein said plurality of supports includes exactly two supports.

9. The antenna of claim **1** wherein said radiating elements transmit electromagnetic signals.

10. An antenna for simultaneously receiving separate electromagnetic signals comprising:

a ground plane with a length, said ground plane having a vertical axis along said length;

a plurality of radiating elements, said radiating elements comprised of first and second co-located, orthogonal dipoles, said first dipoles aligned at substantially a +45 degree angle with respect to said vertical axis, said second dipoles aligned at substantially a −45 degree angle with respect to said vertical axis, said radiating elements and ground plane producing a first electromagnetic field;

a plurality of non-conductive supports connected to said ground plane, said supports perpendicular to said vertical axis and placed between selected of said plurality of dipole radiating elements;

a plurality of independent metallic parasitic elements unconnected to said dipoles and placed in a selected of said plurality of supports, said first electromagnetic fields exciting currents in said metallic parasitic elements, said currents creating second electromagnetic fields, said second electromagnetic fields canceling with portions of said first electromagnetic fields; and

diversity reception means coupled to said plurality of radiating elements for selecting between said plurality of electrical signals.

11. The antenna of claim **10** wherein said parasitic elements are composed of aluminum.

12. The antenna of claim **10** wherein said parasitic elements are positioned along an upper surface of said supports.

13. The antenna of claim **10** wherein said plurality of supports is located midway between said antennas.

14. The antenna of claim **10** wherein said ground plane is composed of metal.

15. The antenna of claim **10** wherein said plurality of radiating elements includes exactly four radiating elements.

16. A method for providing high isolation for an array of radiating elements comprising the steps of:

simultaneously receiving separate electromagnetic signals;

providing a ground plane having a vertical axis;

providing a plurality of dipole radiating elements, said radiating elements comprised of first and second co-located, orthogonal dipoles, said dipoles aligned at a predetermined angle with respect to said vertical axis, said radiating elements having a top surface;

producing first electromagnetic fields in said radiating elements responsive to said electromagnetic signals;

providing a plurality of non-conductive supports, and placing said supports perpendicular to said vertical axis and between selected of said plurality of dipole radiating elements;

providing a plurality of independent metallic parasitic elements unconnected to said dipoles and placed in a selected of said plurality of supports;

exciting currents in said metallic parasitic elements;

creating second electromagnetic fields radiating from said parasitic elements; and

canceling with portions of said first electromagnetic fields with said second electromagnetic fields.

17. The method of claim **16** comprising the further step of placing said parasitic elements midway between the top surfaces of said radiating elements and said ground plane.

18. The method of claim **16** comprising the further step of orienting the radiating elements at a predetermined angle with respect to the vertical axis of the array.

19. An antenna for simultaneously receiving separate electromagnetic signals comprising:

a ground plane with a length and having a vertical axis along said length;

a plurality of dipole radiating elements, said radiating elements comprised of first and second co-located, orthogonal dipoles, said dipoles aligned at first and second predetermined angles with respect to said vertical axis, said radiating elements producing first electromagnetic fields in response to said electromagnetic signals;

a plurality of non-conductive supports, said supports connected to said ground plane and parallel to said vertical axis and placed adjacent selected of said plurality of dipole radiating elements;

a plurality of independent metallic parasitic elements unconnected to said dipoles and placed in a selected of said plurality of supports, said first electromagnetic fields exciting currents in said metallic parasitic elements, said currents creating second electromagnetic fields, said second electromagnetic fields canceling with portions of said first electromagnetic fields.

20. The antenna of claim **19** whereby said first predetermined angle is substantially equal to +45 degrees with respect to said vertical axis and said second predetermined angle is substantially equal to −45 degrees with respect to said vertical axis.

21. The antenna of claim **19** wherein said parasitic elements are composed of aluminum.

22. The antenna of claim **19** wherein said supports comprises an upper surface and said parasitic elements are positioned along an upper surface of said support.

23. The antenna of claim **19** wherein said plurality of supports is located adjacent to said radiating elements.

24. The antenna of claim **19** wherein said ground plane is composed of metal.

25. The antenna of claim **19** wherein said plurality of radiating elements includes exactly three radiating elements.

26. The antenna of claim **25** wherein said plurality of supports includes exactly two sets of supports.

27. A method for providing high isolation for an array of radiating elements comprising the steps of:

simultaneously receiving separate electromagnetic signals;

providing a ground plane having a vertical axis;

providing a plurality of dipole radiating elements, said radiating elements comprised of first and second co-located, orthogonal dipoles, said dipoles aligned at a predetermined angle with respect to said vertical axis, said radiating elements having a top surface;

producing first electromagnetic fields in said radiating elements responsive to said electromagnetic signals;

providing a plurality of non-conductive supports, and placing said supports parallel to said vertical axis and adjacent selected of said plurality of dipole radiating elements;

providing a plurality of independent metallic parasitic elements unconnected to said dipoles and placed in a selected of said plurality of supports;

exciting currents in said metallic parasitic elements;

creating second electromagnetic fields radiating from said parasitic elements; and

canceling with portions of said first electromagnetic fields with said second electromagnetic fields.

28. The method of claim **27** comprising the further step of placing said parasitic elements midway between the top surface of said radiating element and ground plane of selected of said housings.

29. The method of claim **27** comprising the further step of orienting the radiating elements at a predetermined angle with respect to the vertical axis of the array.

* * * * *